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ABSTRACT

This report describes a study of the impact of certain educational inputs on the rate of growth in achievement for various types of students in Philadelphia's public schools. Data for the analysis were drawn from pupil histories of 627 students from 103 elementary schools, 553 students from 42 junior high schools, and 716 students from 5 senior high schools. Educational inputs examined included class size, school size, teacher experience, rating of teacher's college, headstart programs, school facilities, and experience and training of school principals. Factors of school climate, such as racial mixture, mixture of high- and low-achieving students, and school disruption were also considered. Findings of the study suggest that while some school resources are effective in improving learning for all students, other inputs are beneficial mainly when targeted to a particular type of student. The study also shows that certain school inputs produce greater achievement growth than others, suggesting that a shift of resources toward the most productive inputs could generate greater achievement growth without increasing overall school expenditures. (Author/JG)

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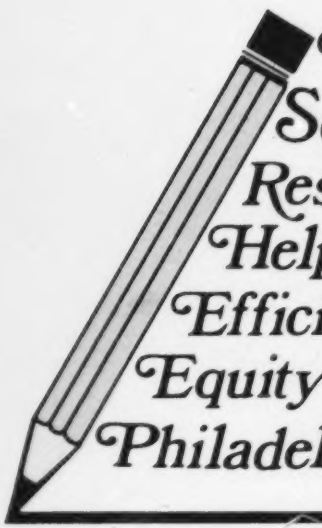

Which School Resources Help Learning? Efficiency and Equity in Philadelphia Public Schools

EA 006 837

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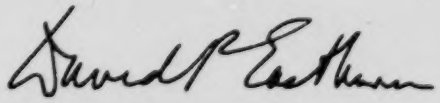
ABOUT THIS ISSUE . . .

The Department of Research of this Bank has undertaken a lengthy study of the educational "output" of Philadelphia's public schools. The findings are reported in this issue. The study examines the relationship between use of school resources and achievement growth of students. A major finding of the study is that, on the basis of the students analyzed, school resources can have an important impact upon how much students learn and can help in compensating for the disadvantages of poverty, race, and low ability, when resources are properly targeted. This finding suggests that the educational achievement of Philadelphia schoolchildren, in some cases, might be increased without necessarily spending more for school resources. That is, redirecting some educational resources is likely to produce productivity gains.

The involvement of the Federal Reserve Bank of Philadelphia in a study of this nature stems from its ongoing interest in productivity of the public sector and in urban finance. In the case of education, productivity gains would reach far beyond the classroom. Boosting learning growth of students now can mean a more productive work force in future years. In short, the school system would be improving the quality of human capital.

The study was conducted by economists whose field of expertise is economics, not education. However, the analytic and measurement techniques of the economics profession are well-suited for studying large social issues. Moreover, the problems that have appeared in education have revolved around efficiency (or productivity) and equity, topics of major concern to economists. While a few of the findings may be controversial to some, neither the economists involved in the study nor the Bank have a particular axe to grind. The primary intent of this study is to provide an objective analysis of school resource use which could point the way to improved learning for this City's schoolchildren, to a more efficient use of citizens' tax dollars, and to providing courts and legislatures with essential information in their quest for equity.

Finally, I wish to express my personal thanks to the School Administration of the School District of Philadelphia for its exceptional cooperation in making its data and knowledge available to us for this study. And I wish to thank the School Board for passing the August 14, 1972 resolution which made the study possible.



David P. Eastburn, *President*
Federal Reserve Bank of Philadelphia

Which School Resources Help Learning? Efficiency and Equity In Philadelphia Public Schools

By Anita A. Summers and Barbara L. Wolfe

Parents of public schoolchildren sue educators because their children are getting less education than others. Taxpayers argue that increased school expenditures aren't increasing education. Government leaders ask whether compensatory educational funds are compensating. And almost everyone thinks that educators aren't being efficient.

This hue and cry over public expenditures for education, how they are spent and how they are distributed, is not surprising. Education is big business in the United States. Public school spending consumes about 8 percent of the gross national product; in Philadelphia, for example, it represents over 30 percent of total governmental outlays. And education is considered a vital component of equal opportunity.

Missing from much of the debate is a clear and workable definition and agreement on what the public schools are here to do—in other words, what is the *output* of the education industry? Lacking a measure of output, debates in budget hearings and the courts therefore focus on the *inputs* of the educational process, although even these are not rigorously examined. Until plaintiff and defendant, finance director and school superintendent, and taxpayer and pupil each keep the same educational score card—that is, until they all look at the same range of school inputs in relation to agreed-upon goals of the school system—confusion is likely to be the order of the day.

The Research Department of the Federal Reserve Bank of Philadelphia has completed a study of a sample of Philadelphia public school students in elementary, junior and senior high schools. The project uses *growth* in achievement as its yardstick in measuring the output of the educational process, and then examines the impact of variations in a large number of inputs on that output.

The major finding, in contrast to some well-known studies, is that school inputs (such as class size and teacher experience) do help students grow in educational achievement and can compensate for the disadvantages of poverty, race, and low ability. Moreover, many inputs have a larger impact on some students' perfor-

mance than others. Small classes, for example, help low achievers, but are of no special benefit to average and high achievers.[1] Further, some characteristics of staff inputs—extra educational credits of teachers, for example—do not appear to boost learning.

EDUCATION: AN ECONOMIC PERSPECTIVE

Peter Pupil, the raw material of the educational "production" process, enters the public school system with a certain set of *socioeconomic inputs* or characteristics—for example, family income and background, race, sex, and IQ (see Appendix for complete list). He gets tested on his achievements in reading, writing, and arithmetic at an early stage. The main job of the school system, many would agree, is to transform Peter Pupil into a better-educated product by improving his reading, writing, and arithmetic skills.[2] He, therefore, goes through several years of schooling exposed to many *school inputs*—a set of class sizes, experienced and inexperienced teachers, and different school sizes, to name just a few. All the while, he is exposed to various characteristics of *school climate*—such as number of disruptive incidents, the racial mixture of the school, and the relative abilities of his fellow students. He is tested again at this later stage. How much has he grown educationally? How much have his reading, writing, and arithmetic skills improved? And what other school inputs have contributed to his improved skills (or output)? Especially important, what factors made him grow more or less compared to other students who came from different family backgrounds, with different abilities, different sex, and different race? In short, which school resources help learning, and how can these resources be allocated to maximize the learning of various kinds of students? (See Box 1 for a discussion of the economist's role in analyzing the allocation of educational resources.)

[1]Average, high, and low achievers are measured by performance on standardized tests in relation to grade level. Thus, average achievers perform at or about grade level, high achievers are above, low achievers below.

[2]In this study, the output of the school system is regarded as growth in achievement over a period of years. Achievement is measured by the available standardized test scores: Iowa Tests of Basic Skills Scores for elementary and junior high students, and the Cooperative School and College Abilities Test, California Achievement Test and Comprehensive Test of Basic Skills for senior high students. Clearly, higher test scores are not the only things educators try to achieve and what parents want schools to do for their children. But, acquiring basic ability in reading, writing, and arithmetic (as measured by tests that convey what most of the outside world regards as measures of relatively the most important function of formal education. Although everyone would agree that these test results convey some important information about what schools are accomplishing.

BOX 1

WHY DO ECONOMISTS LOOK AT EDUCATION?

Economists study how scarce resources are allocated among alternative uses. The analytic and measurement techniques of economics brought the profession into the analyses of many large social issues in the 1960s, education among them. Economists are concerned with equity and efficiency in the allocation process. These issues arise whether they are looking at the economy as a whole or at a private firm. And education is no exception. Since about 8 percent of gross national product is allocated to education, both efficiency and equity considerations have relevance to a large portion of the economy.

First, with respect to equity, a number of problems have appeared. Many disputes involving educational equity have been brought to the courts. The courts have recognized that no clear link currently exists between school resources and educational quality. There has been, in the words of several decisions, no "judicially manageable standard." So, as second best, the courts

BOX 1 (Continued)

have zeroed in on resource inputs to see if they were equally (not necessarily equitably) distributed. Also they have looked at whether the *financing* of education was equitable in relation to the amount of educational resources. However, the courts have been unable to come to grips with the issue of whether these resources have bearing on student achievement (a quality measure). A measurable relationship between student achievement and the volume and quality of school resources is essential, then. Such a relationship could help to gauge and enable the attainment of equity goals as they are set by the courts, parents, educators, and state and Federal government managers of educational funds.

Second, economists typically approach problems with an eye toward maximizing efficiency—that is, getting the most output from a given set of inputs, or a given amount of dollars. Noneconomists in the public sector, where survival does not depend upon the discipline of the marketplace, tend to do this during budgetary crises. Educators, and the public sector generally, are now experiencing fiscal crunches. Consequently, they are exploring ways of getting more output for the same or less cost. Improving efficiency in education requires, as a first step, a disciplined look at just which school resources, if any, improve achievement growth for different types of students. And, along the way, it will also become clear which school resources are unproductive in improving achievement levels. Then, a simple reallocation of resources (not necessarily more resources) would yield greater achievement growth—that is what is meant by being more efficient.

Economists have something to say about efficiency and equity in education because they look at learning in a way which is analogous to a production process. Educational achievement, like shoes, canned tuna, and clean streets can be regarded as the output of a production process. In dealing with a process which involves so many immeasurable human elements, of course, many aspects of the process will not be captured by the production analogy. But, those which can be captured can be usefully viewed this way.

The process begins with something in a relatively unfinished state—the genetically and environmentally developed first grader, the leather, the writhing tuna, and the littered streets. Inputs of labor, capital, and organization are applied and an output results. In education, the product is a pupil achieving at a certain rate. In order to be efficient at this "production" task, educators must arrange the school resources (inputs) available to them in such a fashion that they generate the largest growth in achievement (output) for different types of students.

When economists examine this production process, they try to isolate the impact of a particular input on the output. In theory, they hold all other inputs unchanged, and then alter the amount of the particular input to see what change in output occurs. For example, in education the output may be regarded as the achievement growth of a student. Now if this student had more remedial training, with all other school and socioeconomic inputs held constant, would his achievement growth change? This is the kind of question economists are asking.

In practice, economists do not have the option of shifting inputs about to examine the latter's impact on output. Hence, they look at past data where such shifts have occurred and try to determine the impact on output. Several statistical tools or techniques are available to them (see Appendix for a description of the regression technique used in this study). These cannot establish that the change in an input *caused* the change in output. They do, however, identify a relationship between inputs and output. And it is on the basis of this relationship that policy conclusions may be reached.

The findings which follow are addressed to the question of how student achievement growth can be increased through school resource allocation. But they should not be regarded as *the* answer. Although the data are extensive and the analysis is careful, the findings are drawn from a sample of students observed over a few years (see Box 2 for a description of the student sample). It is an unfortunate characteristic of social science investigations, in contrast to the pure sciences, that replication is difficult, if not impossible. If a second, identically constructed study were done with another group of students, the results would certainly not be identical. However, the broad findings—those related to targeting resources to pupils and those related to the resources which are less effective—are firm enough in this study and supported enough by other studies to warrant confidence.

WHICH SOCIOECONOMIC INPUTS AFFECT LEARNING?

An important and repeated finding of many studies searching for the answers to questions about educational achievement has been that the pupil's background—family income and race, among other things—largely determines his or her performance in school (see Box 3). This has exposed schools to the charge of being relatively ineffective tools for changing the achievement growth of students. A critical ap-

BOX 2

A LOOK AT PUBLIC SCHOOL STUDENTS IN PHILADELPHIA

The exceptional cooperation and data facilities of the Philadelphia School District enabled us to develop a rich data base. Detailed pupil histories, as of 1970–71 or 1971–72, were constructed. We looked at 627 students in 103 elementary schools between the end of the third and the sixth grades, 553 students in 42 schools* between the end of the sixth and the eighth grades, and 716 students in five senior high schools between the ninth and twelfth grades. Though the elementary and junior high schools were a random selection from the Philadelphia school system, the senior high schools were not: They have higher proportions of low-income and Black students than the average. The students themselves were randomly selected from their schools.

In many ways, this provided us with a better basis for analysis than other researchers have been able to obtain: Pupil histories were extremely detailed, following students over time was possible, the number of schools covered was large, and individual pupils were matched with the teachers they had and with the characteristics of those teachers.

What do these students look like? The charts on the adjoining pages show this in some detail. Briefly, though, they are students whose family income averaged less than $10,000 per year, with over 25 percent of the Black students coming from families with incomes less than $6,000. Elementary school students, when they reach the sixth grade, register average achievement scores about *15 months below grade level;* eighth graders average *almost two years below grade level;* and twelfth graders in the sample (having a higher than average number of low achievers) have average scores equal to those in the *bottom fourth in the nation.* Clearly, the teachers and administration of the School District of Philadelphia, like those in other major cities, have a particularly monumental task.

*The 42 schools included elementary, junior high and middle schools. All of these schools in the sample have the seventh and eighth grades.

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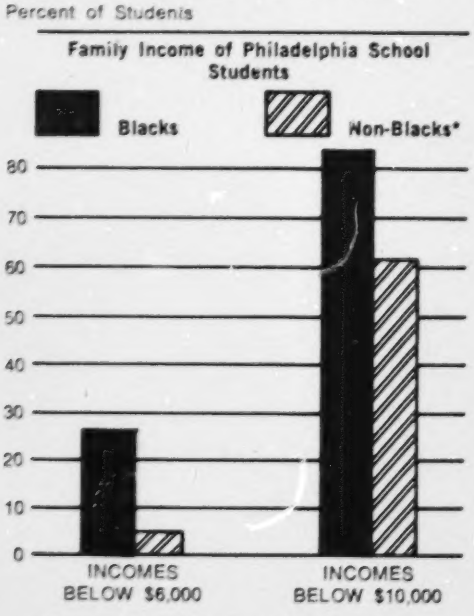
CHART 1

MOST PUBLIC SCHOOL STUDENTS IN PHILADELPHIA CAME FROM FAMILIES EARNING LESS THAN $10,000 A YEAR.

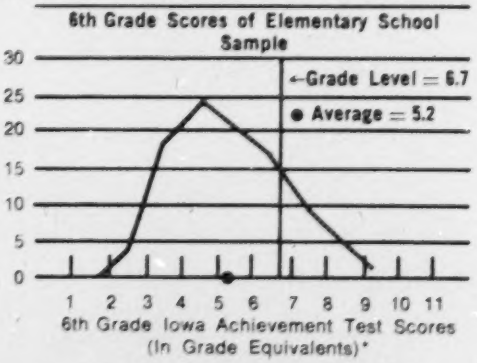


Source: Block income estimates were derived from 1970 Census data for Philadelphia. Block mean housing values, block mean contract rental values, tract distribution of block contract rental values, and tract distribution of income values were used to calculate block incomes. A working paper containing a detailed description of the method, a full statement of the computer program, and a presentation of the block data is available.

* All pupils other than Black pupils.

CHART 2

6TH GRADERS AVERAGED BELOW THE GRADE NORM . . .

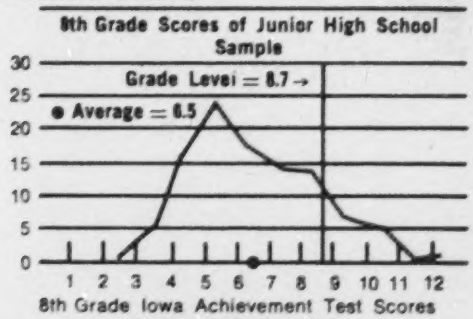


Source: Pupil history files, School District of Philadelphia, 1970-71.

* Raw scores are translated into grade norms. Thus, if a 6th grade student takes a test in April of the 6th grade year, the norm for that student is 6.8.

CHART 3

AND SO DID 8TH GRADERS.

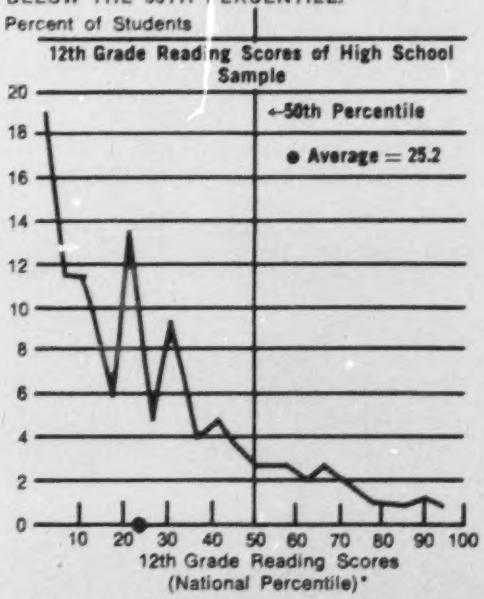


Source: Pupil history files, School District of Philadelphia, 1970-71.

* Raw scores are translated into grade norms. Thus, if an 8th grade student takes a test in April of the 8th grade year, the norm for that student is 8.8.

CHART 4

THE READING SCORE AVERAGE FOR 12TH GRADERS WAS CONSIDERABLY BELOW THE 50TH PERCENTILE.



Source: District Tapes of Philadelphia School District, 1971-72.

* Raw scores are translated into national norms. Thus, if a 12th grade student tests out, in national percentile units, at 50, he or she would be in the middle of the range for the nation.

BOX 3

WHAT OTHER STUDIES SHOW

James S. Coleman,* a sociologist, in his pathbreaking study, found that (1) throughout the school years, family background was the most important factor in determining pupil achievement, (2) the impact on achievement from things schools controlled was barely significant, and (3) that in school the nature of the student body was more important in affecting achievement than anything the schools did.

Arthur R. Jensen,** an educational psychologist, found that 80 percent of IQ is genetically determined and that, therefore, most of the difference in IQs between Blacks and non-Blacks is a matter of inherited genes. He argues, further, that this means that schools cannot succeed in bringing achievement levels of Black students up to those of non-Blacks. His findings were met with a storm of controversy.

Christopher Jencks,*** a sociologist, looked at incomes and occupations in relation to school and family background characteristics (inputs). He found that the quality of schooling and the nature of family backgrounds have a very limited effect on one's future income. Luck plays the most important role of all. The implications drawn are that schools don't make a difference in one's future occupation or income, though some schools may be more pleasant places to be in than others.

*James S. Coleman et al., *Equality of Educational Opportunity* (Washington: Government Printing Office, 1966).

**Arthur R. Jensen, "How Much Can We Boost I. Q. and Scholastic Achievement?" *Harvard Educational Review*, Winter 1969, pp. 1–123.

***Christopher Jencks et al., *Inequality: A Reassessment of the Effect of Family and Schooling in America* (New York: Basic Books, 1972).

praisal of research in this area concluded: "The best information we have . . . is that schools do not now have a tremendous impact on the achievement that does occur."[3]

Income and Race Affect School Impact. Perhaps educational studies have failed to uncover the effective accomplishments of schools because few school inputs consistently benefit all students. For example, low-income students may require a different dosage of certain school resources than high-income students. Many of these studies have been hampered by the limited amount of available data specifically tied to the pupil. Thus, in many studies, the only data available to examine the question of whether or not more experienced teachers help students to achieve more were the *average* experience levels in schools. The preferable data are the experience levels of *specific teachers* confronting *specific pupils*. Therefore, perhaps many negative findings on the effectiveness of school resources emerged because these averages disguised the true impact. For example, if experienced teachers help some students (high income, White, higher ability) achieve and hinder others, then the net result (if only averages are looked at) may well show that experience has no effect. Averaging allows the negative effects to offset the positive ones.

The methods we have used were selected to get at this question of interaction between school

[3]Harvey A. Averch et al., *How Effective Is Schooling? A Critical Review and Synthesis of Research Findings*, The Rand Corporation, R-956-PCSF/RC, March 1972, Santa Monica, California, P. 160.

input and type of pupil. And a great deal of interaction was revealed. We find that for many school resources the effect on some types of students is very different—and, frequently, in the opposite direction from the effect on other types of students. Not only does this finding explain why many studies have concluded that school inputs have little impact on achievement, but our results also point out—most importantly—the direction of how achievement growth can be increased by targeting school resources.

The evidence from this study suggests that reallocating school resources so that they are targeted to those pupils benefiting the most can increase learning. Low-income, Black, or low-ability students are handicapped in terms of expected achievement growth, but our findings indicate that certain school resources can alter this expectation. In fact, our study has enabled us to track down just where being poor, Black, or of low ability plays a role in absorbing (or not absorbing) school resources. So much of this interaction has been identified that no unexplained negative effects of being disadvantaged remain.

Sex. A student's sex is related to his or her achievement at all school levels. Males do more poorly than females in elementary school. In junior high school, only low-ability males fall behind low-ability females. And, in senior high school, males of average ability or less do better than females with equivalent ability.

Starting Scores. A pupil's abilities strongly determine his or her growth in achievement at every level of schooling—that is, if a student begins school with a higher ability, he or she will learn more rapidly. But, at each level, the data show that if a high-achieving Black student and a high-achieving non-Black student start out with the same test score in the Philadelphia school system, the non-Black student will move further ahead.

Motivation. A student's motivation affects his or her learning. For all students, at each level of schooling, more unexcused absences (which are regarded as reflecting poorer motivation) are associated with less learning growth. And being in school more days goes along with more learning growth. But, high-income students appear to be the biggest losers from poor attendance. This finding may mean that when an advantaged student misses school it signals a far more serious negative attitude toward education than when a disadvantaged student does the same thing.

Residential Moves. Junior high students seem particularly sensitive to some socioeconomic characteristics. The results suggest that coming from a family that moves more frequently has an adverse effect on the achievement growth of junior high students. In contrast, frequent family moves appear to show little or no effect on elementary or senior high students.

Native Born. Not being born in one of the 50 states (and having parents who were also not born in them) is associated with lower achievement for early teen-agers in the Philadelphia public schools. Most students in this group are probably of Puerto Rican origin, so language barriers may be the cause of their difficulties.

Summary. The socioeconomic background of the pupil clearly plays an important role in what the student achieves through the school years. The sex of the student can be a handicap, as can race, income, and abilities. But, these handicaps are not "immutable" if they can be overcome—at least in part—through what the schools can do.

WHICH SCHOOL INPUTS AFFECT LEARNING?

Socioeconomic factors are not within the immediate control of school administrators and teachers; class and school size and teachers' experience are. And, if the spirit is willing, changes can be made in how these school inputs are allocated.

Class Size. The findings on class size should be regarded as indications for possible directional changes, rather than as literal indicators.

Elementary students in our sample who are below grade level gain in classes with less than 28 students, but the rest of the students, can, without any negative effect on achievement, be in classes up to 33. For all elementary students, in the sample, being in classes of 34 or more has a negative effect, and increasingly so as the size of the class increases. It is possible that the negative relationship may arise from a teacher's hostile reaction to a class size larger than mandated by the union contract, rather than from largeness itself. In junior high school, classes of 32 or more showed lower achievement growth for the sample students, with low-income students experiencing the greatest negative effects from larger classes. Senior high English classes that did not exceed 26 had the highest learning rates (for students of any ability described by the sample); low-ability students benefited the most from smaller classes.[4]

Chart 5 shows the range of class sizes of the sixth, eighth, and twelfth graders in our sample. The average class size of each of these levels approximates the optimal one for the sample. However, a fair proportion of students are in larger classes—classes so large that they impede learning growth.

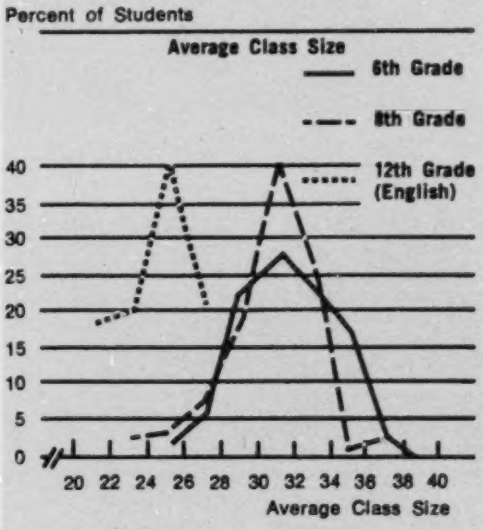
Size of School. In smaller schools increased learning at the elementary and senior levels appears to take place. Black elementary students seem particularly to benefit from being in smaller schools, and low achievers in smaller senior high schools. At the junior high level, school size seems inconsequential over the range examined. It seems, however, much more beneficial to be in an eighth grade that is part of an elementary school than in one that is not. Chart 6 shows the wide range of school size in the Philadelphia School District.

Teacher Experience. As Chart 7 indicates, 27 percent of the teachers had three or less years of experience, 37 percent had more than three but less than ten years, and 36 percent had ten or more years of teaching behind them. These differences in teaching experience, according to our study, have an impact on achievement growth.

Many studies have found that although teacher experience is not a very important factor, it is helpful in the more than three and less than seven-to-ten years experience span. These studies, however, did not examine the impact of teacher experience on students with different abilities. Yet, it seems reasonable to expect that the impact of teacher experience on achieve-

CHART 5

WHILE AVERAGE CLASS SIZE IN PHILADELPHIA SEEMED TO BE CONSISTENT WITH LEARNING GROWTH OF NONDISADVANTAGED STUDENTS, THERE WAS A WIDE SPREAD IN CLASS SIZES.

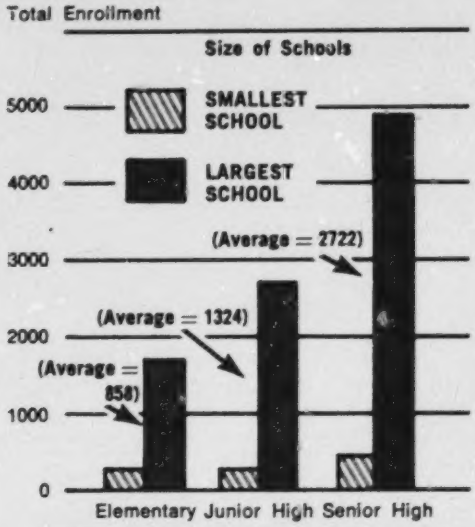


Source: *Monthly Attendance Reports*, October 1970, School District of Philadelphia.

[4]The September 1, 1972 to August 31, 1976 *Agreement between the Board of Education of the School District of Philadelphia and the Philadelphia Federation of Teachers* calls for a maximum class size throughout all levels of schooling of 33 by September 1, 1975, and a longer-term goal of 30 in elementary school, and 25 in secondary schools.

CHART 6

PHILADELPHIA PUBLIC SCHOOLS VARIED CONSIDERABLY IN NUMBERS OF PUPILS ENROLLED.



Source: *Monthly Attendance Reports*, October 1970, School District of Philadelphia.

ment would vary with the type of student.

In Philadelphia elementary schools, length of experience has a very different impact on the high and low achieving pupils in our sample. High achievers seem to do best with more experienced teachers. However, these teachers slow the learning growth of low achievers who seem to do best with new, relatively inexperienced teachers. Perhaps these teachers have undampened enthusiasm for teaching those who find it hard to learn.

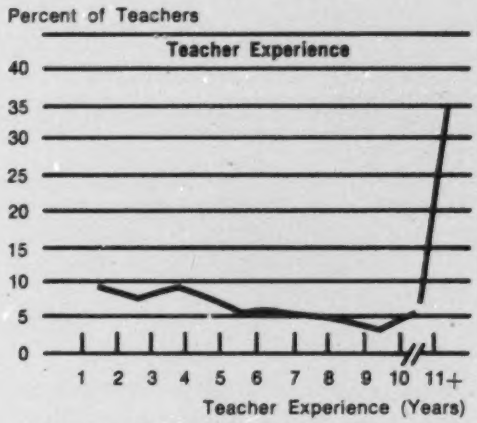
In junior high, an experienced English teacher appears to be particularly effective with high-ability students, but experience of ten or more years helps all students. The pattern of effectiveness for mathematics teachers differs somewhat. Instructors with three to nine years of experience are particularly effective, but those having more than ten years actually reduce the rate of learning mathematics. This latter effect arises, perhaps, because these teachers received pre-Sputnik training. They were teaching the New Math, even though they were not originally trained to teach it.

Rating of Teachers Colleges. Most teachers in the Philadelphia School District went to schools rated lower than, for example, Pennsylvania State University (which had a rating of 502 on a scale of 250 to 800).[5] Does where a teacher went to college (or what it implies) affect a student's learning?

[5]The Gourman rating, published in *The Gourman Report* (Phoenix, Arizona: The Continuing Education Institute, 1967), was used. It is a rating of the undergraduate programs of nearly all colleges and universities in the United States, with information drawn from professional societies, commercial publications, foundations, etc., as well as the institu-

CHART 7

THIRTY-SIX PERCENT OF THE TEACHERS HAD 10 OR MORE YEARS OF EXPERIENCE.



Source: Philadelphia School District data, 1971-72.

Clearly, in some parts of the school system teachers from colleges with higher ratings prove to be more effective teachers. Elementary school students who study with teachers from colleges and universities rated 525 or higher achieve at higher rates. All students do better, especially those in the low-income category. In junior high, having attended schools with higher Gourman ratings seems to matter very little in the teaching of English or mathematics, but it helps in the teaching of social science—especially for high-ability students.

Summary. In short, some school inputs can heighten student achievement: Classes over certain sizes reduce learning; smaller elementary and senior high schools increase it. Net output may be increased by targeting teacher experience and higher-rated college background to the appropriate students. Moreover, some of these school inputs can help offset the initial learning handicaps of race, income, and capability.

WHICH SCHOOL INPUTS DON'T MAKE A DIFFERENCE?

Sifting out the school inputs that are less productive is almost as important as pinpointing those that improve learning. Many inputs miss the goal of increasing learning. This does not mean, automatically, that expenditures for them should be reduced to zero. On the one hand, without some minimum level of expenditures, negative effects on achievement growth might result; on the other hand, with much more than our present level of expenditures, positive effects might result. *Further, the objective of many school inputs is not limited to the objective defined in this study—growth in achievement scores.* Objectives such as racial attitudes and a sense of participation in the democratic process may also be part of the desired outcome of the educational process. But, in terms of the achievement objective, and within the range of expenditures the School District budgets, some school inputs do not appear to improve learning.

Headstart participation does not improve a child's achievement growth by the latter half of elementary school. But such participation does contribute to the child arriving in the third grade at an improved *level* of achievement. This finding is consistent with many Headstart evaluations made around the country.

The general physical facilities of schools have little to do with the quality of a student's learning. More or less playground space, more or less crowded science labs, a new or old school building, or a building rated higher or lower in general physical condition seem to make little difference when achievement test scores are the measure of the student's output.[6] If there are benefits from better facilities, the data do not reflect them. Some facilities, of course, may be far more important in imparting specialized knowledge than they are in imparting the knowledge tested on the general achievement scores reviewed. Furthermore, good facilities may be important in attracting and retaining good teachers.

The measurable characteristics of school principals do not appear to be clearly related to increasing student achievement. There is a wide range among Philadelphia public school principals in experience, graduate degrees, and extra educational credits, but no particular beneficial impact on student achievement emerges in that range. Principals receive salary increments on the basis of a rating of the "difficulty" of a school. Not using the measurable characteristics as a basis for reward is entirely consistent with our findings that they are not productive in terms of achievement. Most likely, the characteristics of school principals which might be effective, such

tions themselves. The areas rated include (1) individual departments, (2) administrations, (3) faculty (including student/staff ratio and research), (4) student services (including financial and honor programs), and (5) general areas such as facilities and alumni support. The Gourman rating is a *simple average* of all of these.

[6]This finding is confirmed by most of the large studies by social scientists, including James S. Coleman. Educators have done little investigation of this, however.

as leadership or organizational skills, are not picked up by these measures.[7]

Whether teachers have more or less education beyond the B.A. or *fare better or worse on the National Teacher Examination (Common)* does not seem to make them more effective educators. Neither of these factors appears to result in increased productivity. The absence of impact on achievement of extra training is consistent with many education studies and with the large-scale studies by social scientists—yet teachers who take extra educational work beyond the B. A. are rewarded with salary increases, unlike principals. Increased use of in-service training in Philadelphia may reflect an awareness of the need for different training. The discriminatory powers of the National Teacher Examination were evaluated by the School District in 1972. The School District concluded that the examination should not be the *only* measure of a teacher's potentiality; our findings suggest that it should not be used as any measure.

Whether the race of the teacher does or does not match the race of the pupil appears to be unrelated to student learning. Whether a teacher is Black or non-Black seems to be similarly unrelated to achievement growth.

Within the range of expenditures on *counseling* and *remedial education*, no particular benefit in terms of increased learning is discernible. Both of these are designed to be compensatory—that is, students having more difficulty receive more remedial work and guidance counseling. But, apparently, the amount spent and/or the techniques used are inadequate for the job. Low-income and low-achieving students are not doing better with more remedial resources.

In sum, there are a number of examples where extra school inputs do not appear to help students learn. Some of these resources may relate to other objectives of the school system. And some may be employed too sparingly to produce achievement growth. In either case, a careful reappraisal of school resources that do not seem to aid learning is appropriate.

[7]A well-known education study confirms this: See Neal Gross and Robert E. Herriott, *Staff Leadership in Public Schools: A Sociological Inquiry* (New York: John Wiley and Sons, 1965).

WHAT ASPECTS OF SCHOOL CLIMATE AFFECT LEARNING?

School integration is customarily discussed in terms of "racial balance" but, in the broader sense, it can apply to balancing income and abilities as well. It is a common misconception that the percentage of Black students, the percentage of low-income students, and the percentage of low achievers are the same group. They do, indeed, overlap. But they are far from identical, and lumping them into one category would be inappropriate and inaccurate—for example, three-fifths of the students whose family income was over $7,000 tested below grade level in the sixth grade.

Therefore, the effects of concentrations of each of these groups need to be examined separately. Attending a school with different concentrations of race, income levels, and abilities might shape a student's learning. In addition, disruptive incidents (assault, fire bombs, drugs, robbery, and use of weapons) might have an impact on learning. Our findings show that except for average family income of the school population, school climate factors greatly influence learning in Philadelphia public schools.

Racial Balance. In 1954 the U. S. Supreme Court, as part of the famous *Brown* v. *Board of Education* decision declaring *de jure* school segregation unconstitutional, stated:

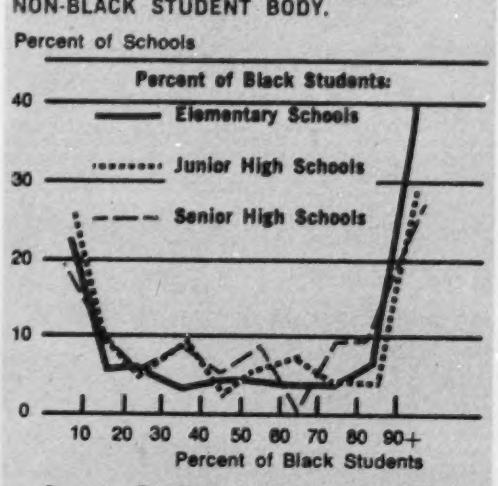
> Segregation of white and colored children in public schools has a detrimental effect upon the colored children. The impact is greater when it has the sanction of the law; . . . Segregation with the sanction of law, therefore, has a tendency to *retard the educational and mental development of Negro children* and to deprive them of some of the benefits they would receive in a racially integrated school system . . . [Emphasis ours.]

Does segregation affect achievement? *It cannot be emphasized strongly enough that objectives other than achievement gains may dominate the decision to desegregate schools, but knowing the impact on achievement (as best it can be measured) of any desegregation target is relevant.* Busing for desegregation purposes could create separate effects on achievement, but these, of course, are not reflected in our findings.

Many schools in Philadelphia have a high proportion of Black students, while many others have a high proportion of non-Blacks. In 1970–71, 23 percent of the elementary schools, 26 percent of the junior highs, and 18 percent of the senior highs had less than 10 percent Black students. And 40 percent of the elementary schools, 28 percent of the junior highs, and 27 percent of the senior highs had student populations that were more than 90 percent Black (see Chart 8).

CHART 8

THERE WERE A SIGNIFICANT NUMBER OF SCHOOLS IN PHILADELPHIA WITH EITHER A PREDOMINANTLY BLACK OR NON-BLACK STUDENT BODY.



Source: *Enrollment Negro and Spanish-Speaking in the Philadelphia Public Schools, 1970-71.*

In elementary school, when all other school characteristics are unchanged, Black and non-Black students appear to have the largest growth in achievement when they are in schools with a 40 to 60 percent Black student body, rather than in schools that are more or less racially segregated. The stimulative effect seems to be true both for Black and non-Black pupils in the sample. *In short, all elementary school students in the sample benefited in terms of achievement when they were in schools where the percentage of Blacks about equaled the percentage of non-Blacks.*[8]

In junior high school, the impact of the racial balance on Black and non-Blacks varied. In general, junior high students seem to be more sensitive to a number of factors in their surroundings which don't influence their elementary and senior high counterparts. For example, they respond, in terms of learning, to whether they have moved about more or less frequently and whether they and their parents are native born. Perhaps the different sensitivity of Black and non-Black students to the proportion of Blacks in the school is related to the general psychological make-up of early teen-agers.

For Black and non-Black students in the junior high sample there is a very slight positive effect in attending schools ranging up to half Black. After 50 percent, however, Blacks experience significant learning growth as the proportion of Blacks in the school increases (all other factors remaining the same). Yet, although non-Blacks

[8]Most of the studies on this subject have concentrated on the impact on Black students being in a segregated versus a desegregated school. Many studies have shown no difference in terms of achievement levels. Coleman's study, and a reworking of his data, show some benefit to Black students of being in classes with more non-Black students. Our results confirm these latter findings and, even further, indicate that non-Black students do better. This finding probably emerges because it is the *change* in achievement, rather than just the level, on which we are focusing.

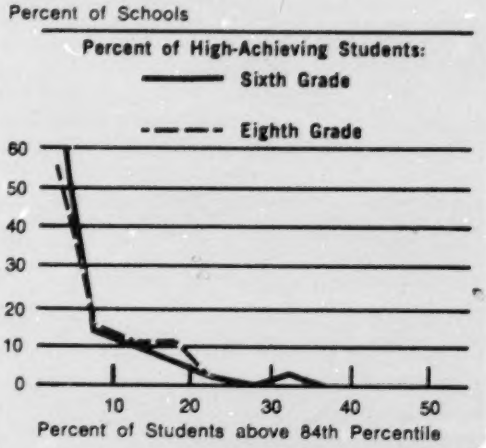
gain in integrated schools up to half Black, they seem to experience some learning declines when they attend schools that are more than half Black.* At a racial balance somewhere around 50 percent, therefore, it appears that Black pupils will not experience the negative effects of a *non-Black segregated* school, and non-Blacks will not experience the negative effects of attending a *Black-segregated* school.

Our sample of *senior high* students includes data from only five schools. In this sample, 88 percent of the students were Black, and the proportion of Blacks in the schools ranged from 55 to 99 percent. No strong impact on Black or non-Black student achievement, one way or the other, was found. However, the range examined was so narrow that no decisive conclusions can legitimately be drawn.

Achievement Mixture. The proportion of either high achievers or very low achievers in a school can have an impact on learning. Charts 9 and 10 provide an overview of the variation among schools of the intellectual strength and weakness of the Philadelphia student population. A very large percentage of elementary and junior high schools have a very low percentage of high-achieving students. (As shown in Chart 9, 70 to 75 percent of these schools have less than 10 percent high-achieving students.) And many schools—52 percent of the elementary schools and 43 percent of the junior high schools—have more than half of the student body achieving at very low levels (Chart 10). It turns out, according to our study, that the nature of the mix does seem to make a difference in student achievement growth.

CHART 9

A VERY LARGE PRECENT OF SCHOOLS HAD A VERY LOW PERCENT OF HIGH-ACHIEVING STUDENTS.



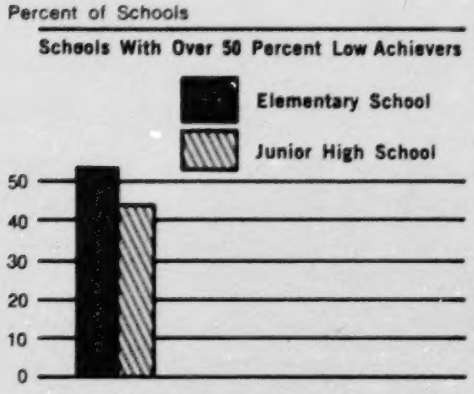
Source: *Report of the Spring 1970 Achievement Test Results*, School District of Philadelphia.

Elementary school students in the sample who test at grade level or lower perform distinctly better when they are with more high-achieving students. Students performing above their grade level are not particularly affected. Therefore, it is the low achievers mixing with high achievers who seem to benefit most. Variations in the proportions of low-achieving students also have little effect on the high achievers, although being in a student body with more low achievers than high achievers appears to have a negative effect on learning for those in the middle. All of this suggests for elementary schools, that high achievers go along on their own steam, relatively unaffected by variations in the percentage of top

*It might appear from these conclusions that Black students in junior highs should be in segregated schools, since they do better in schools with more Blacks. However, it is essential to recognize that the junior high school characterized by more Black students is also the one with fewer high-achieving and more low-achieving students. These characteristics also affect learning growth (described in the next section). Some of the benefits for Black students of being where there are more Black students, then, may in practice be offset by the disadvantages of being where there are more low achievers and fewer high achievers. (See Anita A. Summers and Barbara L. Wolfe, "Philadelphia's School Resources and the Disadvantaged," *Business Review* of the Federal Reserve Bank of Philadelphia, March 1974, pp. 3–16.)

CHART 10

A VERY HIGH PROPORTION OF SCHOOLS HAD MORE THAN HALF OF THE STUDENT BODY ACHIEVING AT VERY LOW LEVELS.



Source: *Report of the Spring 1970 Achievement Test Results*, School District of Philadelphia.

and bottom achievers. But the intellectual composition of the student body, from top to bottom, directly affects learning, especially for the low achievers. In other words, the student body appears to be better off in terms of learning the more heterogeneous the composition regarding abilities.

Junior high students all seem to benefit alike when they are part of a student body with high achievers. They do not appear to lose when they are part of a student body with more low achievers, however. If, therefore, junior highs were made more heterogeneous with respect to ability, some students would gain (where the proportion of high achievers would increase) and some would lose (where the proportion of high achievers would decrease), but low achievers would appear to be the biggest gainers.

In senior high schools, the proportion of high and low achievers referred only to performance on reading tests, and, further, the schools in the sample had very few high achievers. Variations in these proportions showed no impact, but another meaningful measure—high school dropouts—did: the greater the proportion of dropouts in a school, the less learning there is in the student body. And, particularly hard hit, in terms of achievement growth, seem to be the high achievers.

In general, then, peer group abilities influence student achievement. Therefore, it would seem that considerations of desegregation should apply not only to race, but also to student abilities.

Disruption. If a school has fairly serious disruptions such as stabbings, robberies, and rapes, what impact does this (and all that disruption reflects) have on the achievement gains of students? In elementary, junior high, and senior high schools, a greater occurrence of harsh incidents lowers the achievement growth of high-achievers significantly, but low achievers are affected much less. School policies which help reduce the number of serious incidents, then, will improve the learning of testable skills of middle- and high-achieving students. However, since most major incidents of this sort are undoubtedly the consequence of a general malaise, merely stationing police in the corridors (and thereby reducing the number of incidents) may not be the policy which contributes to learning.

In general, then, the more heterogeneous a student body is in terms of race and achievement, the better a student body will fare in learning basic skills. Further, a school that is relatively free of disruption is one where more skills learning will occur.

CONCLUSIONS

The major finding emerging from this sample of Philadelphia public school students suggests that certain school inputs do make a difference in achievement growth. Many school resources are effective in improving learning for all students—and, many are particularly effective

when they are targeted to the type of students who will benefit most. Students disadvantaged by socioeconomic characteristics can be brought to learning rates closer to those of advantaged students if particular resources—teachers from higher-rated colleges, for example—are placed in front of them. High ability students can be lifted to higher learning rates if some resources are directed specifically to them—such as experienced elementary school teachers. In addition, using resources to change school climates can improve student achievement growth. For example, reducing the number of disruptive incidents in schools can boost learning. More racial integration and mixing more higher achievers into the student body can also push learning rates up. In short, how school resources are allocated does have an impact on pupil performance. (See Box 4 for a full summary of the specific findings of this sample.)

The finding that school resources influence learning growth has several important policy implications. *First, public school resources can be used to attain greater equity in educational opportunity.* Some compensation to students disadvantaged by the incomes of their families, the pigment of their skins, and/or the number of their IQs can be achieved by targeting particular school resources to them. This finding is especially significant because it varies from the con-

BOX 4

SUMMARY OF FINDINGS

All types of students at all levels of schooling experience larger rates of growth in achievement if they are attending more, and if unexcused absences and lateness are minimized. Regarding these attendance features as important signals and effectively reacting to them will result in increased learning. Reducing the amount of serious disruptions in schools will increase learning—resources directed to this problem has a direct payoff.

All types of students in elementary school do better if they are taught by teachers who graduated from higher-rated colleges, if they are in a school with a 40 to 60 percent Black student body, if they are in classes of 33 or less, and if they are in a school with more high achievers.

All types of students in junior high school do better if they go to a school which is part of an elementary school, if they have social studies teachers who graduated from higher-rated colleges, if they have mathematics teachers who were trained in the post-Sputnik New Math era, if they are in classes of 31 or less, and, again, if they are in a school with more high achievers.

All types of students in senior high school do better if they are in smaller schools where dropouts are less of a problem.

Disadvantaged as well as advantaged students are helped by all these factors, but they can be helped even further by particular types of resources being targeted to them.

Black students with high IQs would benefit if home and school would allow them to achieve as much as non-Black students with the same high IQ, especially in the early grades. Later on is too late—Black and non-Black students with the same third grade achievement levels grow at the same rate in the higher grades. Black students perform better in smaller elementary schools and in junior highs with larger Black populations.

Low-income students respond particularly well to elementary school teachers who

BOX 4 (Continued)

graduated from higher-rated colleges and to junior high classes smaller than 32.

Low achieving students are particularly responsive to certain school inputs. In elementary school, low achievers do better if they are in classes with less than 28 students, if they have new teachers, and if they are in schools with more high achievers. In junior high, this group performs better with new English teachers and with more high achievers in the school. And in senior high this group responds to English classes that have less than 27 students and to smaller schools. Presumably, at every level, a redesigned remedial education program—since the present one does not seem to be helping low achievers—would be helpful.

High achievers do best with experienced elementary school teachers and junior high English teachers, junior high social studies teachers from higher-rated colleges, more library books, and with senior high English teachers with higher English exam scores. If they are in an environment with less disruption and fewer dropouts, and if they move less during their junior high years, they do better.

clusions of other major education studies which indicate that school inputs are not effective in compensating the disadvantaged. It is also significant because it means that the courts and legislatures can get a measurable handle on educational equity in terms of *output*—achievement growth—rather than the traditional approach which measures equity in terms of inputs—such as expenditures per pupil. Thus, if achievement growth is acceptable as a major goal of the educational system, equity attainment relates to what the student gets from his or her education, rather than what the schools put into him or her. It also suggests that state and Federal compensatory funds, now compensating for income and population density characteristics, would more appropriately be compensating for low achievement.

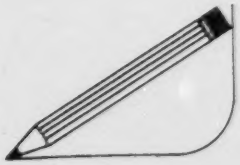
The second policy implication suggested by the finding has to do with educational productivity. Some school inputs produce greater achievement growth than others. Thus, shifting resources toward those inputs could generate a larger educational output without raising School District expenditures.

Our study of the School District sample data for 1968–72 suggests that, on efficiency grounds, some school resources could be drawn away from those activities where extra inputs don't seem to make much difference (such as extra teacher education, physical facilities above the minimum, and unproductive class sizes). Further, some school resources could be shifted to those activities which seem to be particularly productive (making schools more heterogeneous with respect to race and ability, and smaller elementary and senior high schools are examples). More particularly, school administrators might do well to put those resources which are particularly effective for low achievers with that group (smaller classes in elementary school and English classes in senior high are examples.)

Making teacher salary scales more reflective of productivity would also help. Extra education of teachers does not appear, directly, to produce achievement results, although it is a characteristic for which teachers are rewarded. There are other characteristics of teachers which do play an important role in the learning process. Identifying and rewarding these would make salaries more reflective of productivity. For example, graduating from a higher-rated college seems to be a "productive" characteristic of teachers (in terms of achievement growth), though currently this is not rewarded or even used as a basis for hiring. In sum, a careful appraisal of the allocation of school resources and the reward system might well produce important productivity

gains.

A third broad policy implication arising from this study concerns accountability. The concept of holding a person responsible for seeing that resource expenditures produce a specified output is an old one in the private sector. For example, stockholders hold management accountable for using resources to generate profits. The practice has proved more difficult to apply in the public sector, however, because of the difficulty of identifying outputs (and relating them to specific inputs) and because of the absence of a profit measure. Yet, an important finding of this study is that in the educational process specific school resources can be tied to learning. The implication, if achievement growth is accepted as a principal goal, is that taxpayers, parents, and courts could hold school administrators accountable. Such a result would benefit all concerned. Most important, however, students might well have a better chance of reaching their educational potential.



APPENDIX

The data used in this study were obtained from elementary, junior, and senior high schools, pupil history files, and personnel files. They were in a form that permitted the matching up of school resources, school climate, and Bureau of Census data to individual pupil data.

The following data classified as socioeconomic, school resources, and school climate were examined for all three levels.

Socioeconomic

- Sex
- Race
- "Family" income
- Density of Census tract
- Days present
- Unexcused absences
- Latenesses
- Marital status of parents
- IQ*
- Residential moves
- Pupil born in U.S.
- Second-generation American
- Iowa test scores (reflecting initial abilities)

School Resources

- Headstart participation*
- Size of school
- Size of class
- Number of pupils per lab***
- Playground footage per pupil*
- Condition of school
- Classification of school
- Date school built
- Capacity utilization
- Basic grade organization
- Library books per pupil
- Number of school librarians
- Number of nonteacher professionals
- Teacher's experience
- Teacher's exam score—common
- Teacher's exam score—subject
- Gourman rating, teacher's undergraduate college
- Teacher's credits beyond B.A.
- Teacher's race
- Percent of Negro teachers
- Percent of teacher vacancies
- Principal's experience
- Principal's credits beyond M.A.
- Principal's additional degrees
- Total expenditure per pupil
- Total Federal funds expenditure per pupil
- Counseling expenditure
- Remedial education expenditure
- Basic skills expenditure*

School Climate

- Percent of high achievers in pupil's grade
- Percent of low achievers in pupil's grade
- Percent of Negro pupils
- Percent of high school dropouts**
- Percent of Spanish-speaking pupils
- Percent of low-income pupils (free lunches)
- Percent of high achievers in school****
- Percent of low achievers in school****
- Student mobility****
- Average income, school feeder area, 1970
- Average education level, adults 25+, school feeder area
- Change in feeder area income, 1960–70
- Number of disruptive incidents
- Average daily attendance
- Percent of 1972 graduates planned to continue education**
- Percent of 1972 graduates unemployed, Nov. 1972**
- Percent of 1972 graduates attending college, Nov. 1972**

*Elementary only.
**High school only.
***Not elementary school.
****Not high school.

STATISTICAL PROCEDURES

For each level of schooling, equations were estimated where the change in achievement growth of each pupil during the period under study (dependent variable) was explained by a set of socioeconomic, school resource, and school climate factors (independent variables). These equations essentially state that for any particular student, his or her achievement outcome is determined by background factors, amounts and quality of school resources, and the climate of the school that the pupil attends.

Generally, we think of many things affecting pupil achievement. Multiple regression analysis permits the empirical testing of these relationships. Essentially, this statistical procedure permits the sorting out of the separate effects of different factors entered into each equation. If, for example, we have an equation with two explanatory variables, X_1 = IQ and X_2 = percent of high achievers and the dependent variable Q = change in student achievement in grade equivalent form, and the equation is

$$Q = 10.04 + .15X_1 + .7X_2,$$

it would be interpreted in the following way: The coefficient .15 means that, with the percentage of high achievers fixed, an increase of 1 point on an IQ test is expected to generate a .15 month increase in student achievement growth. The coefficient .7 means that, holding IQ constant, a 1 percentage point increase in the percentage of high achievers is expected to lead to a .7 month increase in student achievement growth.

A measure is needed to judge the reliability of these estimates. The formal statistical test for this looks at the value of the coefficient compared to the standard error of the coefficient. The standard error measures the spread or how far, on average, the likely values of the coefficient are from the estimated mean value of the coefficient. To be statistically significant 95 percent of the time, that is, to be different from zero 95 percent of the time, the value of the coefficient must be approximately twice the size of the corresponding estimated standard error. Strictly speaking, this only applies to one testing of a hypothesized relationship. Since we engaged in extensive empirical testing and refining of these relationships, we do not use these results rigidly, but use them only as general indicators of statistical significance.

Thus, multiple regression analyses permit us to isolate the effects of certain factors and see if there is a regular relationship between any one explanatory variable, holding all others constant, and growth in pupil achievement. It also enables us to define the size or magnitude of each relationship. The amount of the variation in growth in achievement that is explained by all the variables in the equation is measured by the coefficient of multiple determination, the R^2. The R^2 takes on values between 0 and 1. The closer R^2 is to unity, the greater the explanatory power of the equation. An R^2 of .32 means that the equation explains 32 percent of the variation—and leaves 68 percent unexplained.

INTERPRETING THE TABLES

Three tables follow: Table 1 describes the sixth grade results, Table 2 the eighth grade results, and Table 3 the twelfth grade results. The tables are derived from equations which explain achievement growth.

Output Measure. Table 1 describes the findings that relate to the achievement growth of elementary school pupils, as measured on standardized tests. Tests were taken in the spring of the third grade and the spring of the sixth grade. The difference between these two, the growth over the period, is used as the measure of the pupils' achievement growth. The results thus refer to change over a three-year period and are measured in grade equivalent form.

Table 2 describes the findings that relate to the years sixth through eighth grades. Standardized tests were taken in the spring of the sixth grade and the spring of the eighth grade. The difference between these two, the change over the period, is used as the measure of achievement growth. The results refer to growth over a two-year period. They are also expressed in grade equivalent form.

Table 3 describes the findings of the twelfth grade. These results are limited to tests on English exams, and to pupils attending schools in Districts 1, 2, 3, 4 only. Tests were taken in the ninth and twelfth grades. The difference between these is used as the measure of achievement growth. The results, thus, refer to a three-year period. These are in national percentile form since the grade equivalents are not available.

Input Measure. In the tables that follow, the left-hand column lists the explanatory variables—the socioeconomic, school resource, and school climate variables that affect pupil achievement growth. The right-hand column describes the findings, giving detailed information on the difference that the unit variation in the explanatory variable makes on achievement growth. Wherever this effect is significantly different for different types of students, these differences are described.

TABLE I

SIXTH GRADE RESULTS

Variable	**Findings:** Results expressed in units of three-year growth.*
Sex	Over this period, males grew .9 months less than females.
IQ	For all pupils who scored between 80 and 100 on the first grade IQ test, a 10-point higher IQ means 1.3 months more growth. For White pupils who scored 110 or better on the IQ test, a 10 point higher IQ means 2.9 months more growth, while for Black pupils who scored 110 or better, a 10-point higher IQ means only .55 months more growth.
Unexcused absences	Unexcused absences have a negative effect on achievement. The negative effect is greater for the more advantaged students, higher income, and White students. Five additional absences per year for a student whose family income is $10,000 means a decline in growth of 2.13 months, while for a student whose family income is $7,000, the five additional unexcused absences mean a 1.32 months decline in achievement growth.
Latenesses	Latenesses have a negative effect on achievement growth. The effect is greatest for low-income pupils. Five more latenesses per year means 2.9 months less growth to a pupil whose family income is $5,000 and 1.2 months less achievement growth for a student whose family income is $8,000.
Sixth grade teacher's college rating (Gourman)	Having a teacher who attended a college rated 525 or better, compared to below 525 has a positive effect on low- and middle-income pupils. In terms of achievement growth this means 8.7 months more growth to the pupil whose family income is $5,000, 4.2 months to the pupil whose family income is $10,000.
Sixth grade teacher's experience	Teacher's experience has a positive effect on average and above average students. A student who is at grade level in the third grade (=3.8) will increase achievement growth by .6 months for each three additional years of teacher's experience (to 11 years). A student scoring 5.0 will increase by 1.3 months per three additional years experience. Below grade level, down to 2.0, additional experience has no effect. Below that, it reduces growth. At a score of 1.5, three years more experience means .63 months less growth.
Sixth grade teacher's exam	As a teacher's score on the National Teacher Exam increases by 50 points, pupil achievement growth declines by .75 months.
Library books	As one more book per pupil is added to the library, pupil achievement growth declines by .5 months.

*Average growth equals two years, three months over the three-year period, end of third grade to end of sixth grade. The R^2 of this equation equals .28 with growth as the dependent variable, .74 with the absolute level of the sixth grade score as the dependent variable.

TABLE 1 (Continued)

Class size	Being in a class of 34 or more reduces achievement growth by 2.1 months. Being in a class of 28 to 33 rather than a class of less than 28 has no effect on students who scored at grade level in third grade, a negative effect on low achievers, and a positive effect on high achievers. The negative effect is 1.6 months for a pupil who scored 2.0; the positive effect is 2.4 months for a pupil who scored 5.0.
School size	Larger schools have a negative effect, particularly for Black pupils. An increase of 300 in enrollment means .6 months less achievement growth for White pupils, 3.5 months less achievement growth for Black pupils.
Percentage of Black pupils	As all pupils go from a less than 20 percent Black school to a 20 to 40 percent Black school, achievement growth increases by 3.3 months. Similarly, going from a less than 20 percent Black school to a 40 to 60 percent Black school means a 5.6 month increase in achievement growth or an additional growth of 2.6 months over 20 to 40 percent Black schools. Going from a less than 20 percent Black school to a 60 percent more Black school means an increase in achievement growth of 4.3 months or 1.3 months less than a 40 to 60 percent Black school.
Percentage of high achievers	Being in a grade with more pupils who scored at the 85th national percentile or higher has a positive effect on achievement growth which is strongest for low achievers. A 5-percentage point increase in the percentage of high-achieving students means an increase in growth of 1.0 months to a pupil at grade level, 2.0 months to a pupil below grade level (at 2.0), but no significant effect to a pupil above grade level (at 5.0).
Percentage of low achievers	Being in a grade with more pupils who scored below the 16th national percentile means .7 months less growth for each 10-percentage point increase.
Disruptive incidents	More disruptive incidents in a school have a negative effect on high achievers. An increase of three in number of incidents means a decline in growth of 1.4 months to a high-achieving pupil (at 5.0).

TABLE 2

EIGHTH GRADE RESULTS

Variable	**Findings:** Results expressed in units of two-year growth.*
Sex	Among low-achieving students, males grew 2.0 months less than

*Average growth for pupils in sample equals one year, two months in two years from the end of sixth grade to the end of eighth grade. The R^2 of this equation equals .31 with growth as the dependent variable, .85 with the absolute level of the eighth grade score as the dependent variable.

TABLE 2 (Continued)

	females. For the rest, sex made no difference in achievement growth.
Second-generation American	Students who were born in one of the 50 states and whose parents were born in one of them grew four months more in achievement. The effect is strongest for low-income pupils.
Earliest score	All students benefit from having a higher third grade score, but the effect of an additional month higher score diminishes as third grade score goes up. For low achievers (around 1.5), the positive effect is .4 per additional month higher third grade score. For average achievers (around 3.0), the positive effect is .25 per additional month higher score. For high achievers (around 4.5), the positive effect is .12 per additional month higher score.
Sixth grade score	All students tend to move toward the average over the testing period. For students below the average (=5.6) in sixth grade testing, the growth rate is greater by 3.4 months for each 10 months below average. For students above average in sixth grade testing, growth is less by 3.4 months for each 10 months above the average. This may, in part, reflect some error in test measurement.
Unexcused absences	Unexcused absences have a negative effect on those who scored at 5.0 and above on the sixth grade test, and the effect is greater for higher achievers. Five more unexcused absences per year means .78 months less growth to a pupil who scored 5.0, 1.69 months less growth to a pupil who scored at grade level (6.8), and 2.30 months less growth to a pupil who scored above grade level (at 8.0). The effect is also more negative as a pupil's income increases.
Days present	For all pupils, 10 additional days present means .53 months more achievement growth.
Residential moves	Residential moves have a negative effect on high achievers and higher-income pupils. Below grade level at 5.0, each additional move reduces achievement growth by 1.8 months, at grade level (6.8) it reduces achievement growth by 3.6 months, while above grade level (8.0) it reduces achievement growth by 4.8 months.
Eighth grade social studies teacher's college rating (Gourman)	Having a social studies teacher who attended a college rated 50 points higher on the Gourman rating, increased achievement growth for grade level and higher than grade level pupils, .5 months for grade level, .9 months for above grade level (at 8.0) but had no effect on below grade level pupils.
Eighth grade social studies teacher's subject exam	For all students, a 10-point increase in their teacher's score on National Teacher Social Studies Exam meant a .8 months increase in achievement growth.
Eighth grade English teacher's experience	The experience of the English teacher does not affect achievement growth, positively or negatively, through the ninth teaching year. Having an English teacher with 10 or more years experience, however, increases achievement growth by 3.8 months, both for the tenth and eleventh-plus years. The positive effect is strongest for high-achieving pupils. For very low-achieving pupils the effect of more experience is negative.

TABLE 2 (continued)

Eighth grade math teacher's experience	One to two years experience of the math teacher has no positive or negative effect on pupil growth; three to nine years experience increases achievement growth by .4 months for each year, while ten or eleven-plus years reduces achievement by 2.1 months for the tenth and eleventh-plus years.
Pupil race = race of eighth grade math teacher	If the math teacher's race is the same as the pupil's race, student achievement growth is 2.1 months more.
Percentage of Black teachers	As the percent of Black teachers increases by 10 points, pupil achievement growth declines by 1.5 months.
Library books	Library books have a positive and increasingly positive effect on achievement growth of pupils scoring 6.0 and above. At grade level (6.8) each additional book increases pupil growth by .48 months; above grade level (at 8.0) the increase is .68 months.
Remedial expenditure per low achiever	Remedial expenditures have a positive effect on non-low achievers—.3 months per $10 increase, but essentially no effect on low achievers. The effect is also only positive for higher-income pupils.
Class size	Being in a class size of 32 or more, compared to a class of less than 32 has a negative effect on those with family incomes of $10,000 or less. The negative effect is 2.4 months for a $10,000 income pupil, 4.3 months for a $5,000 income pupil.
Eighth grade part of elementary school	Being in an elementary school in the eighth grade increases pupil achievement growth by 4.3 months.
Percentage of Black pupils	For non-Black pupils, being in a school with an increasing percentage of Blacks, up to 50 or 60 percent, may possibly increase their achievement growth by .5 months per 10-percentage points increase. Above this percentage Black, the effect may be negative, 1.3 months per 10-percentage points increase. For Black pupils, being in an increasingly Black school, through 50 to 60 percent may possibly have a very slight positive effect; above that, the effect is stronger and positive, 1.4 months per 10-percentage points increase.
Disruptive incidents	More disruptive incidents in a school have a negative effect on high achievers. An increase of three incidents means a decline in growth of .36 months for the high achiever.

TABLE 3

TWELFTH GRADE RESULTS

Variable	**Findings:** Results expressed in terms of change in national percentile rating of change in national percentile rating on English exams over three-year period.*

*Average growth equals 2.25 from testing in ninth grade to testing in twelfth grade. The R^2 of this equation equals .32 with growth as the dependent variable, .58 with the absolute level of the twelfth grade score as the dependent variable.

TABLE 3 (Continued)

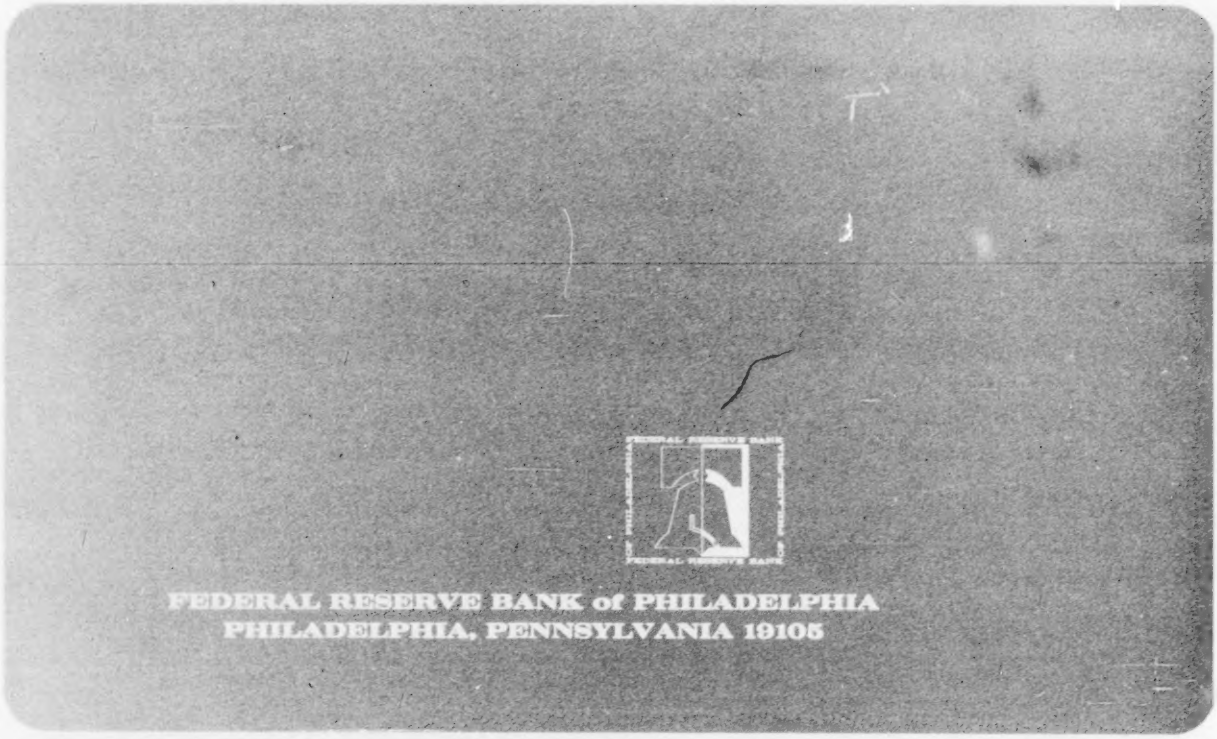
Sex	Among the low achievers, males grew more than females. For those who scored at the 10th percentile in ninth grade, males grew 2.4 percentage points more than females. For those who scored at the 20th percentile in ninth grade, males grew 1.4 percentage points more. Among other pupils there were no differences by sex.
Race	For high-achieving pupils, the effect of being Black on achievement growth is negative. For students who scored at grade level in the seventh grade (7.8), achievement growth is 7 percentile points less if the pupil is Black and the negative effect increases as the seventh grade achievement score increases. Pupils who scored one or more years below grade level are not adversely affected by being Black.
Seventh grade score	For all students, a one month higher score on the sixth grade test means a 1-percentage point higher growth in achievement.
Ninth grade score	All students tend to move toward the average score. For students below the average, ninth grade SCAT score (=23 percent), the growth rate is 1.9 national percentile points greater per 1 point below average. For pupils above average, the growth rate is 1.9 percentile points less per one point above average. This may, in part, reflect some error in the test measurement.
Unexcused absences	Unexcused absences have a negative effect on achievement. Five more unexcused absences per year means .4 national percentile points less growth in achievement.
Latenesses	Latenesses have a negative effect on achievement and the effect is stronger for higher achievers. At the ninth grade average (23 percent), five more latenesses means .5 percentile points less growth. At 40 percent, five latenesses means 1.1 percentile points less growth.
Twelfth grade English teacher's subject exam	Below the average score (23 percent), having an English teacher who scored 10 more points on this teacher's exam has no effect. At the average score and above, it has a positive effect. At the average (23 percent) the positive effect is 1.1 percentile points per 10 percentage points on the English teacher's subject exam. Above average (at 40 percent), the positive effect is 2.8 percentile points per 10 points.
English class size	Larger classes have a negative effect on low achievers, no negative or positive effect on average achievers, and a positive effect on those who scored at the 50th national percentile or above. For those at the 10th percentile, the negative effect of having one additional student in a pupil's English class is .7 percentile points. For those at the 5th percentile, the negative effect is .92 percentile points. The negative effect is most pronounced comparing class sizes of above 26 to those below 26.
Percentage of dropouts	Being in a school with a higher percentage of dropouts has a negative effect on achievement growth for most students. It has no negative or positive effect on very low achievers. At the average (23 percent) the effect of 5 percent more dropouts is 1.2 percentile points less growth. Above average (40 percent) the negative effect is about 2.9 percentile points.
Percentage of Black pupils	The range in this sample is limited to 55 to 99 percent Black pupils. As the percentage of Black pupils increases by 5 points, Black pupil achievement growth increases by .5 points. There is no effect on non-Black pupils.

FOR FURTHER INFORMATION . . .

"Equality of Educational Opportunity Quantified: A Production Function Approach," a technical version of this study, was presented by the authors at the winter meetings of the Econometric Society on December 27, 1974. Copies are available on request from the authors.

The March 1974 *Business Review* contains a study, "Philadelphia School Resources and the Disadvantaged," in which the authors detail how school resources in Philadelphia were distributed to schools in relation to the disadvantaged students. A more technical version of this study is available in the Philadelphia Fed Research Papers, "Intradistrict Distribution of School Resources to the Disadvantaged: Evidence for the Courts." Copies of these are available on request from the Department of Research, Federal Reserve Bank of Philadelphia, Philadelphia, PA 19105.

A working paper containing a detailed description of the method used to obtain block income estimates from 1970 Census data for Philadelphia is available on request. The paper contains a "cookbook" description of the procedure and a full statement of the computer program. Income estimates for each block in Philadelphia are also available.



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